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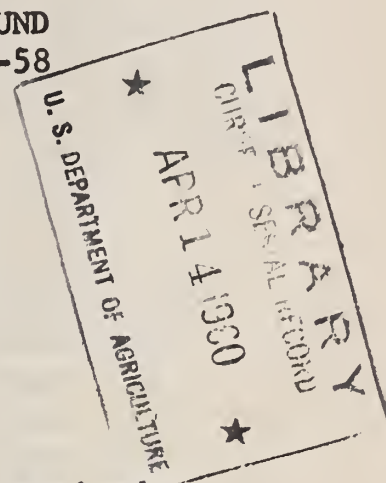
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Agricultural Research Service

INVESTIGATIONS ON EFFECTS OF AIRCRAFT SOUND  
ON MILK PRODUCTION OF DAIRY CATTLE 1957-58

By

J. B. Parker and N. D. Bayley  
Dairy Cattle Research Branch  
Animal Husbandry Research Division



INTRODUCTION

The United States Air Force has, from time to time, received complaints from owners of various classes of livestock relative to adverse effects from noise of jet aircraft. Little research has been conducted to determine the effects of noise stress on livestock. A study conducted for the Air Force at one poultry operation adjacent to a jet base where complaints had been filed indicated no measurable adverse effects. The losses cited in the complaint were shown to have probably been the results of weaknesses in the feeding and management procedures followed on this farm. The preliminary findings of a study on intense reproduced aircraft sound on hogs indicated little or no effect and none on feed gains or reproduction.

In order to determine if there were any adverse effects on dairy cattle the Air Force requested proposals for a study. Two proposals were outlined and submitted to them. The first study was to be a mass survey of all dairies in the vicinity of a number of existing Air Force Bases, where milk delivery information would be available for a period of a year and where such data could be correlated with flight data. Then, if by statistical methods, adverse effects were shown, a more detailed and controlled experimental procedure could be set up to study the physiological responses contributing to these effects.

The study reported here pertains to the survey phase of the proposals suggested to the Air Force.\*

\*Purchase Request 8891, Project 7-(8-7210) Task No. 71729, Delivery Order No. 33(616)57-13, dated 24, January 1957.

## SURVEY PROCEDURE

The existing Air Force bases at which jet aircraft were located were used in this study if there were several dairy herds within three miles of the base, if whole milk from these herds was delivered to a milk plant and daily milk delivery information was available at the milk plants. Eight bases met these qualifications. They were:

1. Dow Air Force Base, Bangor, Maine
2. Laurence G. Hanscom Air Force Base, Bedford, Massachusetts
3. McGuire Air Force Base, Wrightstown, New Jersey
4. Griffiss Air Force Base, Rome, New York
5. Pease Air Force Base, Portsmouth, New Hampshire
6. Lockbourne Air Force Base, Columbus, Ohio
7. Selfridge Air Force Base, Mt. Clemens, Michigan
8. Truax Air Force Base, Madison, Wisconsin

A record of the pounds of milk received daily at the local milk plant was obtained for each dairy herd located within a three mile radius of each air base. The records were restricted to deliveries received during the period from May 1956 through April 1957. Assistance in collecting these data was obtained through the co-operation of The Maine, Massachusetts, New Hampshire, New York, Ohio, Michigan, and Wisconsin Agricultural Experiment Stations.

It was planned to make a detailed analysis by comparing days of flight exposure with days of non-exposure for those herds in line with the runways. The Air Force was requested to furnish the information for the number of flights, runway used, and direction of take-off for each day of the year corresponding to the milk delivery data. However, only one base, of the eight surveyed was in a position to furnish this detailed information. At the other bases the base commanders reported either that such information was not recorded or that the records were destroyed after several months.

From maps of the areas surrounding the air bases, three zone boundaries were established at varying distances from the end of the runways. Zone 1 was within 1 mile, Zone 2 was greater than one but less than two miles and Zone 3 was greater than two but less than three miles distant. Also the dairy herds were classified as "exposed" or "not exposed" to flight activity. "Exposed" herds could be located in any of the three zones but included only those within a prescribed distance of a line drawn longitudinally through the



center of any active runway. This distance was 400 yards on either side of the center line at the end of the runway and was widened as defined by a line departing from the 400 yard limit at an angle not exceeding  $5^{\circ}$ . All herds located outside these limits were considered as "not exposed". The areas prescribed by the limits allowed not only for straight flights after leaving the runway but also for flights when the aircraft were known to turn before reaching the outer boundary of Zone 3. An illustration of the zones and exposed areas is shown in figure 1.

It was not possible to obtain 12 months information from all dairies. Some went out of business, some changed during the year from daily deliveries to every-other day. In a few cases milk was rejected at the milk plant and returned to the producer with no record made of the amount. In the Rome, New York, area a considerable number of producers were caught in the milk strike and had no deliveries for several days. One dairy did not deliver milk on Sunday so that on Monday there was a double amount delivered. All abnormal amounts were excluded and of course where no delivery information was available such days had to be omitted.

Analyses of the data were carried out through consultation with and assistance of The Biometrical Service, Agricultural Research Service, U.S.D.A.

#### ANALYSIS OF DATA

The following table shows the distribution of the herds in the survey according to their location near specific bases, in one of the three zones and in areas exposed or not exposed to flight activity.

LOCKBOURNE A.F.B.

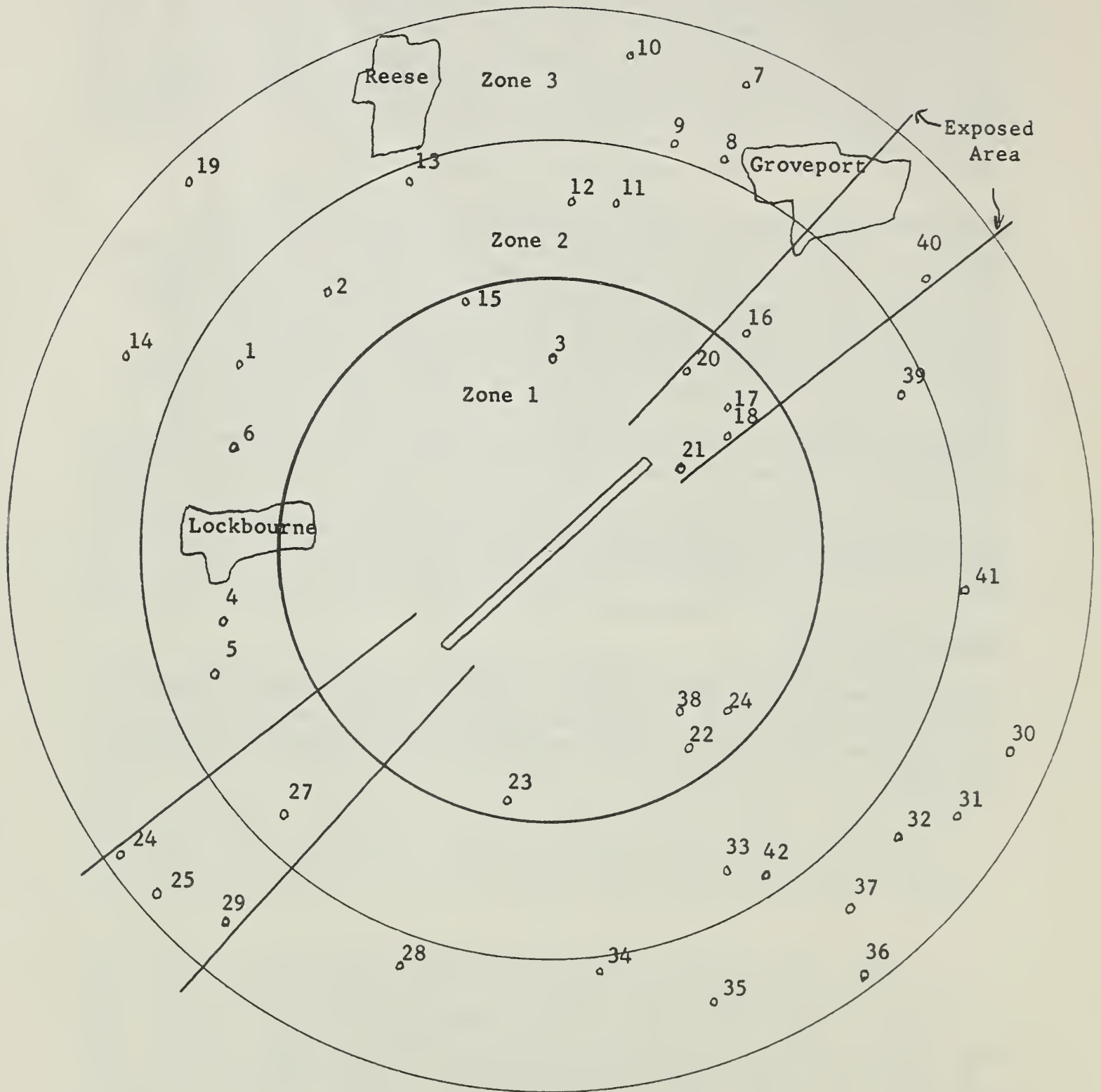


Figure 1

Table 1.-The Distribution of Herds According to Zone, Flight Activity Area and Specific Air Base

		Zone No.					
		1		2		3	
		Not		Not		Not	
Flight Activity		Exposed	Exposed	Exposed	Exposed	Exposed	Exposed
Base No.	Total No. of herds						
1	26	1	2	3	2	11	7
2	9	0	1	0	1	2	5
3	15	0	0	6	6	1	2
4	31	2	1	4	8	4	12
5	14	2	0	0	1	7	4
6	42	4	6	2	11	4	15
7	11	1	0	1	1	3	5
8	34	0	3	2	8	6	15
Total	182	10	13	18	38	38	65

It is worthy of mention that only 13 percent of the 182 herds were located within one mile of the end of the active runways. This indicates that the existing location of jet air bases is not very close to the dairy herds of that particular area. Thirty one percent of the herds were between one and two miles of the runways and 56 percent were between two and three miles distant. Thirty six percent of the herds were located in the areas considered as exposed to flight activity.

#### A. Lockbourne Air Force Base

The data concerning the Lockbourne Air Force Base was more extensive than that obtained from any other. Also from this base it was possible to obtain the day by day flight activity information including the runway used and the take-off direction. Therefore, a separate analysis was conducted with the information on the herds near this base.

An analysis of variance was made of the milk production in the ten herds at Lockbourne Air Force Base which were exposed to flight activity. Flight activity for each dairy was indicated as 1 for days on which flights were made and 0 for days on which no flights were made.

Table 2.-Analysis of Variance of Pounds of Milk Shipped Dairy from 10 herds Exposed to Flight Activity of Lockbourne Air Force Base

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	3103	265,599,338	
Zones	2	30,315,683	15,157,841.5
Herds within zones	7	38,833,718	5,547,674.0**
Months within herds within zones	94	34,973,030	372,053.5**
Flight Activity within zones, herds and months	104	162,332	1,560.9
Days within zones, herds, months and flight activity	2896	3,698,356	1,277.1

\*\* Significant at 1% level



This analysis showed that the variation in milk deliveries resulting from flight activity over these herds was not significant. An examination of the mean daily milk deliveries revealed that five dairies had a higher mean on days of no flight activity than on days of activity. These means were 462.6 pounds and 460.8 pounds respectively. They differed by only 1.8 pounds. The five other dairies had a lower mean delivery on days of no flight activity than on days of activity. These means were 253.8 pounds and 255.2 pounds. The ten dairies showed a mean of 372.3 pounds of milk daily for non-active days and 371.8 pounds for active days.

Because it was probable that the effect of fly-overs might be reflected in the milk deliveries on the day following exposure the data were also summarized in order to evaluate this possibility. The production on a day of exposure following at least one day of non-exposure was compared with the production on the subsequent day. The tabulated results are shown in Table 3. There were obviously no significant differences between the production on the two days.

Table 3.-Comparison of Milk Deliveries on Day of Exposure with Day Following Exposure in 10 Herds Exposed to Flight Activity of Lockbourne Air Force Base

Zone	No.of Herds	Ave. Milk Deliveries - lbs. of milk	
		Day of Exposure	Day following Exposure
1	4	500	502
2	2	283	287
3	4	281	283

Differences between zones in daily deliveries per herd per day were not significantly different when tested by the mean square for variation between herds within zones. This indicates that the proximity of the herds to the end of the runway did not influence the production of the herds. Further examination of the means showed that in Zone 1 there was only a one pound per day difference in milk deliveries per herd on days of flight activity as compared to days of no activity. In Zones 2 and 3 there were no differences related to flight activity.

An analysis was also made of all 42 herds located in the vicinity of the Lockbourne Air Force Base. In this analysis the herds were classified by zones as previously; however, flight activity differences were based on the production of those herds which were located in the "exposed" area as compared to the production of the herds in the "not exposed" area. These areas are shown in Figure 1. The estimate of production on each herd was the average daily production for each month in the study. The analysis of variance is shown below.

Table 4.-Analysis of Variance of Monthly Average of Pounds of Milk Shipped Daily from the 42 Herds Studied in the Vicinity of Lockbourne Air Force Base.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	463	21,564,361	
Zones	2	554,831	277,416
Flight Activity Areas within zones	3	2,781,034	927,011
Herds within zones and flight activity areas	36	15,777,217	438,256**
Months within zones, flight activity areas and herds	422	2,451,279	5,809

\*\* Significant at the 1% level

In this analysis only the differences between herds were significant. This indicates that there is no evidence for effects of zones and flight activity area on milk production of the herds.

An additional analysis was made of the extent to which daily milk deliveries varied in the different zones and areas of flight activity. This analysis was conducted because of the possibility that the fly-overs in the exposed areas might have resulted in more erratic production than in the unexposed areas. The variation in daily deliveries in a herd was measured by the coefficient of variation of these deliveries for each month in the study. The resulting analysis of variance is shown in Table 5.

Table 5.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from 42 Herds in Vicinity of Lockbourne Air Force Base.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	463	20,034.36	
Zones	2	118.61	59.305
Flight activity areas within zones	3	115.50	51.833
Herds within zones and flight activity areas	36	6,126.15	170.171**
Months within zones, flight activity areas and herds	422	13,634.20	32.308

\*\* Significant at 1% level

Only the differences between herds were significant. Flight activity areas and distance from the end of the runways did not show any effect on the variability of daily deliveries.

#### B. Other Bases

In addition to the Lockbourne Base, herds were located in all three zones surrounding two other bases (No's. 1 and 4 in Table 1). The analysis of data regarding these bases is presented in Tables 6, 7, 8, and 9.

Table 6.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds Surrounding the Dow Air Force Base, Bangor, Maine.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	306	317,068,225	
Zones	2	14,971,438	7,485,719.0
Flight Activity Area within zones	3	32,374,324	10,791,441.3
Herds within zones and flight activity areas	20	256,871,814	12,843,590.7**
Months within zones, flight activity areas and herds	281	12,850,649	45,731.8

\*\* Significant at 1% level



Table 7.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds in the Vicinity of the Griffis Air Force Base, Rome, New York.

Source of Variation	d.f.	Sums of Squares	Mean Squares
Total	363	39,101,256	
Zones	2	5,727,543	2,863,771.5*
Flight Activity areas within zones	3	2,039,618	679,872.7
Herds within zones and flight activity areas	25	20,809,399	832,376.0**
Months within zones, flight activity areas and herds	333	10,524,696	31,605.7

\* Significant at 5% level

\*\* Significant at 1% level

Table 8.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of the Dow Air Force Base, Bangor, Maine.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	306	10,248.12	
Zones	2	77.10	38.55
Flight Activity area within zones	3	61.64	20.54
Herds within zones and flight activity areas	20	2,543.14	127.16**
Months within zones, flight activity areas and herds	281	7,566.24	26.93

\*\* Significant at 1% level



Table 9.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of Griffiss Air Force Base, Rome, N.Y.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	363	9,524.97	
Zones	2	10.18	5.09
Flight Activity Area within zones	3	393.20	131.07
Herds within zones and flight activity area	25	1,630.77	65.23**
Months within zones, flight activity area and herds	333	7,490.82	22.50

\*\* Significant at 1% level

There were three bases near which herds were located in both exposed and not exposed areas of Zones 2 and 3 but not in Zone 1. The analyses for these bases are shown in Tables 10 through 15.

Table 10.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds in the Vicinity of the McGuire Air Force Base, Wrightstown, New Jersey

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	163	35,004,623	
Zones	1	6,464	6,436.0
Flight Activity Areas within zones	2	485,738	24,286.9
Herds within zones and flight activity areas	11	31,128,346	2,829,849.6**
Months within zones, flight activity areas and herds	149	3,384,076	22,711.9

\*\* Significant at 1% level

Table 11.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds in the Vicinity of the Selfridge Air Force Base, Mt. Clemens, Michigan

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	130	8,368,369	
Zones	2	2,599,918	1,299,959.0
Flight activity areas within zones	2	2,249,720	1,124,860.0
Herds within zones and flight activity areas	6	2,757,074	459,512.3**
Months within zones, flight activity areas and herds	120	761,657	6,347.1

\*\* Significant at 1% level

Table 12.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds in the Vicinity of Truax Air Force Base, Madison, Wisconsin

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	395	247,337,262	
Zones	2	15,539,185	7,769,592.5
Flight activity areas within zones	2	28,261,340	14,130,670.0
Herds within zones and flight activity area	29	192,524,240	6,638,766.9**
Months within zones, flight activity areas and herds	362	11,012,497	30,421.3

\*\* Significant at 1% level

Table 13.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of McGuire Air Force Base, Wrightstown, N. J.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	163	1,201.04	
Zones	1	19.03	19.03
Flight activity area within zones	2	47.46	23.73
Herds within zones and flight activity area	11	328.93	29.90**
Months within zones, flight activity area and herds	149	805.62	5.41

\*\* Significant at 1% level

Table 14.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of Selfridge Air Force Base, Mt. Clemens, Mich.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	130	2,394.86	
Zones	2	45.42	22.71
Flight activity area within zones	2	169.18	84.59
Herds within zones and flight activity area	6	91.08	15.18
Months within zones, flight activity area and herds	120	2,089.18	17.41

Table 13.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of Truax Air Force Base, Madison, Wisconsin

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	395	7,940.39	
Zones	2	55.44	27.72
Flight activity area within zones	2	20.67	10.34
Herds within zones and flight activity area	29	1,538.61	53.06**
Months within zones, flight activity area and herds	362	6,325.67	17.47

\*\*Significant at 1% level

Finally, there were two bases near which herds were located in both exposed and not exposed areas of Zone 3 but not in Zones 1 or 2. The analyses for these bases are shown in Tables 16 through 19.

Table 16.-Analysis of Variance of Monthly Average of Pounds of Milk Shipped Daily from the Herds in the Vicinity of the Laurence G. Hanscom Air Force Base, Bedford, Mass.

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	104	9,150.503	
Zones	2	2,015,692	1,007,846
Flight activity areas within zones	1	3,291,170	3,291,170
Herds within zones and flight activity areas	5	3,055,124	611,025**
Months within zones, flight activity areas and herds	96	788,517	8,214

\*\*Significant at 1% level



Table 17.-Analysis of Variance of Monthly Averages for Pounds of Milk Shipped Daily from the Herds in the Vicinity of Pease Air Force Base, Portsmouth, New Hampshire

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	149	40,840,837	
Zones	2	15,335,309	7,667,654.5
Flight activity areas within zones	1	76,433	76,433.0
Herds within zones and flight activity areas	10	24,046,141	2,404,614.1**
Months within zones, flight activity areas and herds	136	1,382,954	10,168.8

\*\* Significant at 1% level

Table 18.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of Hanscom Air Force Base, Bedford, Massachusetts

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	104	8,992.09	
Zones	2	3,218.73	1,609.36
Flight activity area within zones	1	513.78	513.78
Herds within zones and flight activity area	5	469.99	94.00
Months within zones, flight activity area and herds	96	4,789.59	49.89

Table 19.-Analysis of Variance of Coefficient of Variation of Daily Deliveries from Herds in the Vicinity of Pease Air Force Base, Portsmouth, New Hampshire

Source of Variation	d.f.	Sum of Squares	Mean Squares
Total	149	4,556.68	
Zones	2	231.87	115.94
Flight activity area within zones	1	75.66	75.66
Herds within zones and flight activity area	10	1,106.63	110.66*
Months within zones, flight activity area and herds	136	3,142.52	23.11

\* Significant at 5% level

The results of the analyses of the data regarding six of the above seven bases were similar to the results obtained for the Lockbourne Air Force Base. However, the analysis for the Griffiss Air Force Base showed significant differences among the mean daily deliveries from the three zones.

This variability in the significance of the differences found has a possible explanation in the fact that the average herd size was markedly different among the zones surrounding the Griffiss Base. The evidence is shown in the Appendix (page 18). It is very likely that if the herds had been of comparable size, the differences found in the analysis would not have been significant.

It should be mentioned here that the design and analysis of the survey were based on the premise that there would be a sufficient number of herds representing each zone and flight activity classification to prevent differences in herd size from biasing the various means. After the data had been assembled, it was found that this was not true in all cases and that size of herd variation would have to be considered when interpreting some of the differences found. From one base (No. 8), data on herd size were available from all the herds. Therefore, the production of these herds was summarized also in terms of the average daily milk delivered per cow. The means obtained with these data for the zone and flight activity classification are shown in Table 20. There was no consistent pattern of the means in regard to either zones or flight activity areas.

Table 20.-Average Daily Milk Delivered per Cow from Herds in Vicinity of Truax Air Force Base, Madison, Wisconsin

Zone	Exposed		Flight Activity Area		Not Exposed	
	No. Herds	lbs. milk per cow per day			No. Herds	lbs. milk per cow per day
1	0	-			3	22.44
2	2	30.24			8	24.86
3	6	25.59			15	28.36

### CONCLUSION

The detailed analysis of the data regarding the Lockbourne Air Force Base as well as the analysis of the less complete data available from the seven other bases showed no evidence of an effect on milk production of dairy cattle resulting from fly-overs by jet aircraft or proximity to the air base. These data failed to indicate a need for detailed physiological research regarding such a possible effect.

### SUMMARY

A survey was made to determine if there was any measurable effect of jet aircraft noise and fly-overs on the production of dairy herds located in the vicinity of existing air bases. Data covering a period of twelve months were obtained on the daily milk deliveries from 182 herds located within three miles of eight Air Force Bases using jet aircraft. Thirteen percent of these herds were within one mile of the end of any active runway; 31 percent were between 1 and 2 miles; and 56 percent were between 2 and 3 miles distant. The herds were also classified as "exposed" or "not exposed" to flight activity according to their location regarding the path of take-off and landing for the aircraft.

An analysis of data from the 42 herds surrounding the Lockbourne Air Force Base and from complete data on flight activity at that base did not show any evidence that fly-overs or proximity to the ends of the active runways had an effect on the milk production of the herds. Comparisons at this base were made between days of flight activity and no activity as well as between the areas mentioned above.

Analyses of the less complete data available at the other seven bases confirmed the results obtained regarding the Lockbourne Base.

The results of this survey did not show a real need for detailed physiological research regarding the effects of jet noise and fly-overs on dairy cattle.



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K. Tabler, Biometric Services, A.R.S., U.S.D.A., Beltsville, Maryland

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APPENDIX

Average Daily Milk Deliveries and Coefficient of Variation  
of the  
Deliveries for Each Herd Included in the Survey

Base 1 - Dow Air Force Base

Flight Activity Area									
Zone	Herd No.	Exposed			Zone	Herd No.	Not Exposed		
		No.of Cows	Ave.Daily Milk Del.	Ave.Coeff. of Var.			No.of Cows	Ave.Daily Milk Del.	Ave.Coeff. of Var.
1	1	-	412.5	6.85	1	9	-	721.2	6.26
					10			205.2	10.63
2	4	57.8	1,545.8	5.05	2	12	-	571.4	5.16
	14	-	381.7	11.85		72	-	161.5	9.87
	68	22.1	573.6	6.68					
3	30	44.2	946.4	8.03	3	43	40.0	982.2	5.53
	40	-	611.0	8.61		49	45.0	1,719.0	7.15
	66	34.0	283.1	8.83		51	20.9	215.0	11.86
	69	-	401.9	8.65		55	-	1,117.0	6.81
	70	-	250.3	12.63		59	15.8	656.1	8.77
	71	-	66.6	17.40		67	-	879.5	4.84
	73	-	121.7	6.98		75	10.7	59.6	13.38
	74	-	310.3	10.68					
	76	-	342.4	7.33					
	77	-	1,492.0	8.03					
	78	-	1,041.4	5.33					

Base 2 - Hanscom Air Force Base

1	-	-	-	-	1	7	25.0	597.1	7.26
2	-	-	-	-	2	4	6.0	172.0	22.51
3	1	20.0	205.0	15.01	3	2	38.0	670.3	8.19
	3	15.0	321.0	14.98		5	45.8	1,140.0	5.60
						6	30.0	875.0	14.20
						8	25.2	638.0	6.14
						9	20.6	482.0	6.78

Base 3 - McGuire Air Force Base

Flight Activity Area									
Exposed					Not Exposed				
Zone	Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.	Zone	Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.
1					1				
2	4	-	656.6	6.74	2	1	-	645.7	7.61
	5	-	1,000.4	3.66		2	-	914.4	5.21
	6	29.75	581.2	8.15		3	-	651.5	7.34
	9	-	670.0	6.41		10	-	705.3	5.34
	12	-	433.6	9.36		11	-	1,679.6	4.46
	13	23.67	754.5	7.60		16	-	466.7	5.98
3	15	-	788.2	4.72	3	7	-	1,480.6	4.83
						14	-	429.6	7.10

Base 4 - Griffiss Air Force Base

1	24	25.0	495.5	5.27	1	19	8.0	165.9	11.74
	28	11.0	180.8	4.85					
2	1	35.3	715.3	10.83	2	5	-	428.8	7.54
	2	-	594.7	8.76		6	-	421.7	12.60
	3	33.3	611.2	8.25		13	-	586.3	7.12
	21	52.0	1,616.0	3.78		17	-	963.4	12.15
						18	-	493.1	10.24
						20	49.9	957.8	5.99
						26	22.9	856.5	4.38
						29	-	974.4	6.59
3	11	-	588.0	7.56	3	4	-	385.1	8.95
	12	-	488.3	8.38		7	28.7	611.6	7.96
	23	-	833.3	6.99		8	-	508.6	9.38
	27	39.0	725.2	5.43		9	-	420.9	12.43
						10	-	705.1	9.09
						14	38.9	952.4	6.72
						15	-	611.5	5.91
						16	-	784.3	8.19
						22	-	503.0	8.52
						25	-	566.4	8.76
						30	-	210.5	11.77
						31	-	249.9	6.29

Base 5 - Pease Air Force Base

Flight Activity Area									
Zone	Exposed				Zone	Not Exposed			
	Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.		Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.
1	11	-	354.9	9.79	1	-	-	-	-
	12	46.4	1,052.2	5.85		-	-	-	-
2	-	-	-	-	2	5	-	518.7	8.83
3	2	-	225.7	11.43	3	1	-	177.7	9.78
	3	-	628.2	6.34		6	-	290.0	13.71
	4	-	113.8	9.63		9	-	578.6	11.47
	7	-	701.3	8.00		13	-	474.5	12.71
	8	-	104.0	16.54					
	10	-	451.5	8.08					
	14	-	37.8	14.44					

Base 6 - Lockbourne Air Force Base

1	17	-	676.7	9.81	1	3	8.0	131.5	10.96
	18	-	881.9	5.92		15	-	107.7	8.98
	20	-	64.8	15.49		22	-	211.4	11.78
	21	15.0	401.8	7.34		23	-	146.8	8.33
						29	-	57.3	16.70
						38	13.2	304.2	9.04
2	16	-	302.7	9.88	2	1	8.5	175.2	15.80
	27	11.0	289.0	6.31		2	-	520.7	4.58
						4	-	280.8	8.70
						5	-	169.3	15.70
						6	34.0	896.7	6.41
						11	-	139.0	16.40
						12	-	189.0	12.80
						13	-	350.9	4.81
						33	10.8	337.2	7.05
						39	-	326.0	11.53
						42	-	115.8	12.40
3	24	-	107.1	11.06		7	17.5	490.4	7.91
	25	6.2	167.4	10.20		8	-	335.7	14.24
	26	4.0	66.1	18.02		9	-	303.6	6.37
	40	-	670.3	5.81		10	5.0	80.3	14.01
						14	-	513.4	8.19
						19	-	199.0	9.28
						28	-	205.3	10.70
						30	-	116.7	11.99
						31	-	237.5	8.25
						32	-	320.7	7.78
						34	-	129.8	16.38
						35	-	121.2	14.77
						36	-	82.2	17.86
						37	3.2	97.6	15.92
						41	-	217.9	7.82

Base 7 - Selfridge Air Force Base

Flight Activity Area									
Zone	Exposed				Zone	Not Exposed			
	Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.		Herd No.	No.of Cows	Ave.Daily Milk Del.	Ave.Coef. of Var.
1	4	-	495.5	8.68	1	-	-	-	-
2	8	-	382.1	7.57	2	22	-	987.4	5.18
3	5	-	462.6	8.50	3	15	-	119.8	7.84
	10	-	290.7	9.90		16	-	167.5	6.45
	12	-	303.2	8.73		18	-	257.7	7.63
						19	-	287.2	6.17
						24	-	691.6	4.67

Base 8 - Truax Air Force Base

1	-	-	-	-	1	14	11.3	116.9	15.38
						21	25.6	847.0	7.21
						27	16.8	401.5	6.68
2	20	19.8	581.0	6.45	2	2	36.2	1,262.6	6.05
	25	22.8	709.9	7.09		6	38.3	846.4	5.71
						17	14.9	303.5	10.58
						19	30.0	667.3	8.03
						22	-	825.5	12.33
						26	19.5	521.9	6.54
						28	23.2	665.9	6.33
3					3	32	24.0	455.5	6.53
	8	24.3	614.8	6.31		1	48.7	1,285.1	6.93
	15	33.5	689.2	6.05		3	28.7	815.9	4.86
	16	17.8	318.8	7.53		4	18.4	407.2	6.96
	18	21.0	551.7	7.67		5	36.6	1,100.2	8.05
	30	16.2	561.1	7.45		7	30.0	960.0	4.94
	31	23.9	689.5	7.54		9	25.2	507.2	9.33
						10	37.2	1,093.6	8.54
						11	37.4	1,018.4	5.68
						12	43.6	1,447.4	5.73
						13	7.0	190.5	13.72
						23	28.3	762.1	6.75
						24	17.2	553.7	6.78
						29	28.2	849.9	7.27
						33	43.6	1,485.9	6.82
						34	5.7	147.1	10.58





